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Electron Fractography Used to Examine Nickel-Base Alloys

The problem:

To establish the causes of metal fatigue and stress failures in nickel-base alloys tested at temperatures ranging from room temperature to 1800°F. Previous methods such as radiographic, ultrasonic, and the use of penetrant dyes did not yield the detail required to reveal the temperature effects on granular structure.

The solution:

An atlas of electron fractographs (microscopic reproductions at high magnification of fractured surfaces) from fatigue specimens of several nickel-base alloys where the test conditions were closely controlled. The technique produced surface features at magnification as high as 9000X with excellent resolution.

How it's done:

An electron fractograph is prepared by making an impression of the surface of the fatigue fracture with a thin plastic or carbon film. By casting or pressing the film against the fracture surface, its details are transferred to the film which may then be reviewed and/or photographed by means of an electron microscope. Contrast is enhanced by highlighting the film

with metal vapors after the transfer and prior to observing.

Notes:

1. This method permits observation of features with dimensions of only 50 Å.
2. Failure of all test specimens at room temperature was transgranular; at temperatures above 1468°F, the failure mode was intergranular.
3. Requests for further information may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
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Huntsville, Alabama 35812
Reference: TSP70-10571

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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